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(54) Character output device

(57) Prior to the printing or display of characters corresponding to a series of code data, a required output condition is selected, and an appropriate output data set for each character is determined, depending upon the selected output condition. Related data relating to the determined output data set is stored into a memory 52. The appropriate output data set is retrieved from a memory 12 according to its related data to generate and output the corresponding character.

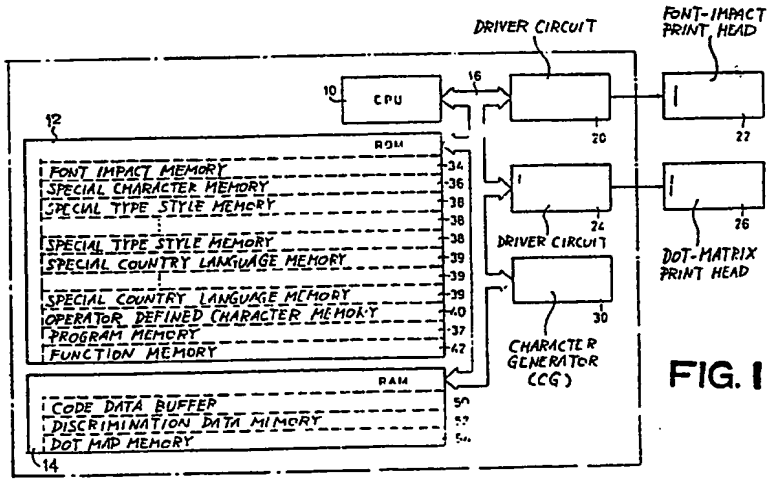


FIG. 1

GB 2 219 880 A

2219880

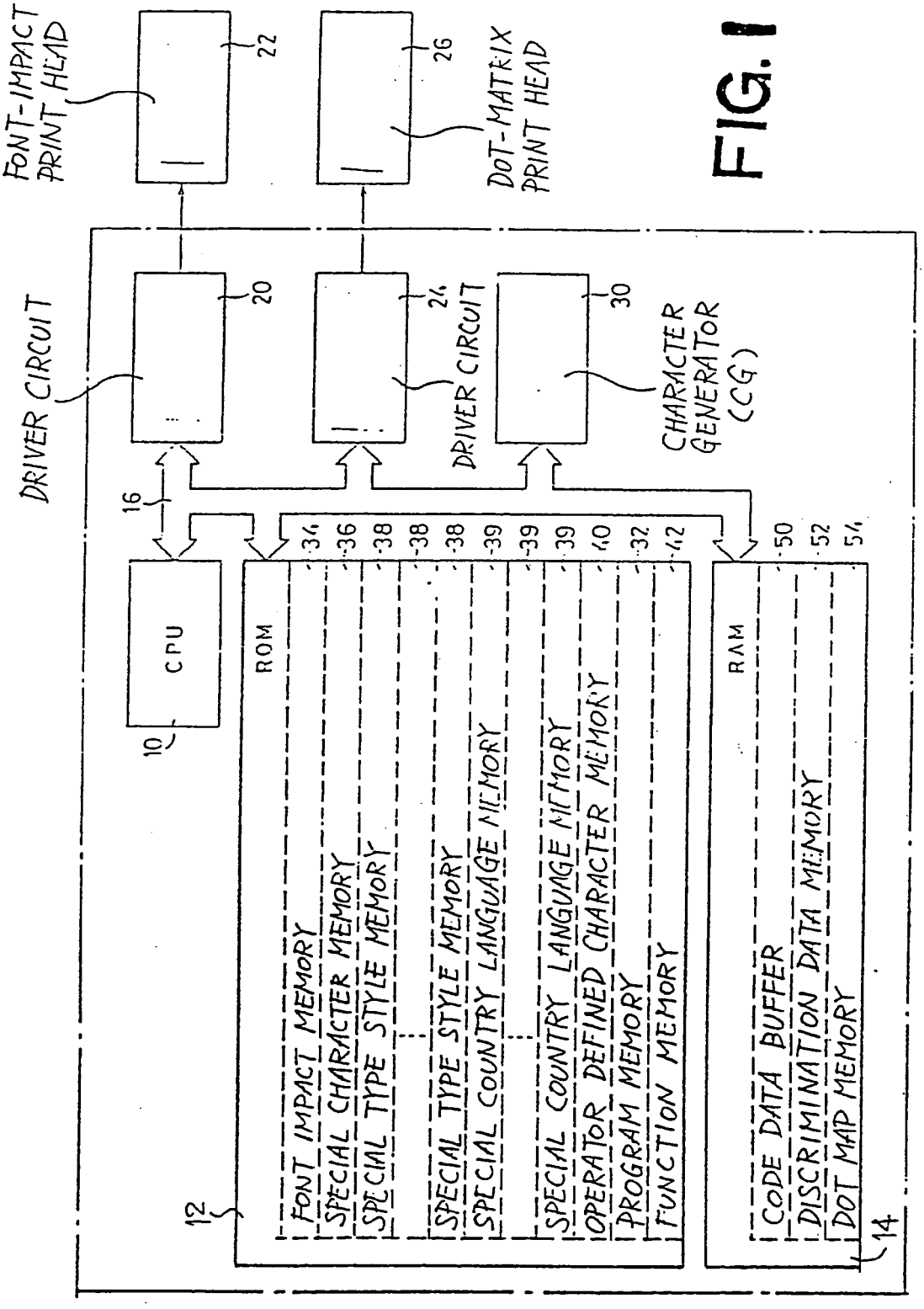


FIG. 1

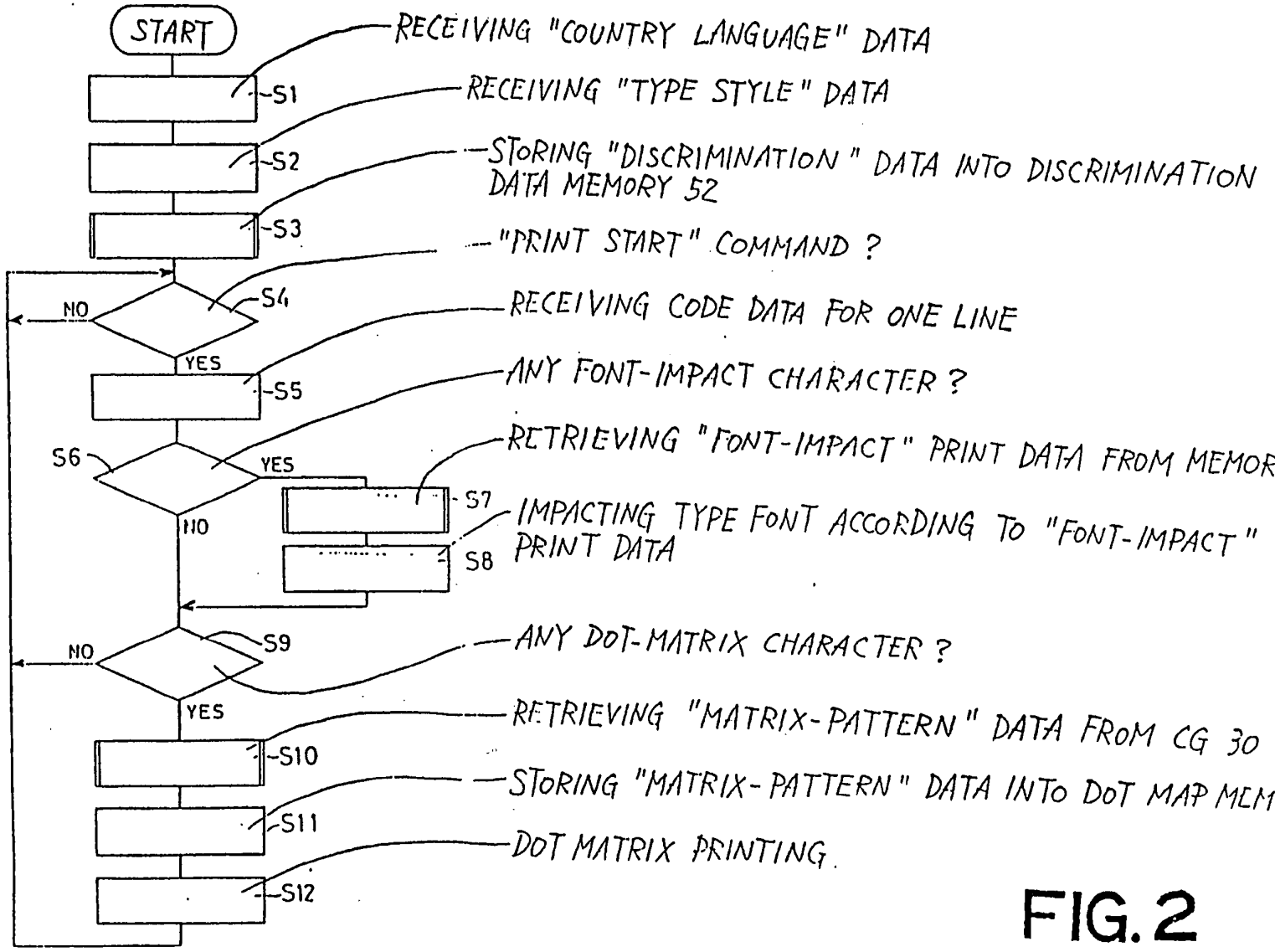


FIG. 2

2219880

2219880

ADDRESS	ARM NO.	TYPE WIDTH (UNIT: 1/60 INCH)	IMPACT PRESSURE LEVEL
200H	24	6	0
203H	25	7	1
206H	30	5	0
⋮	⋮	⋮	⋮

FIG. 3

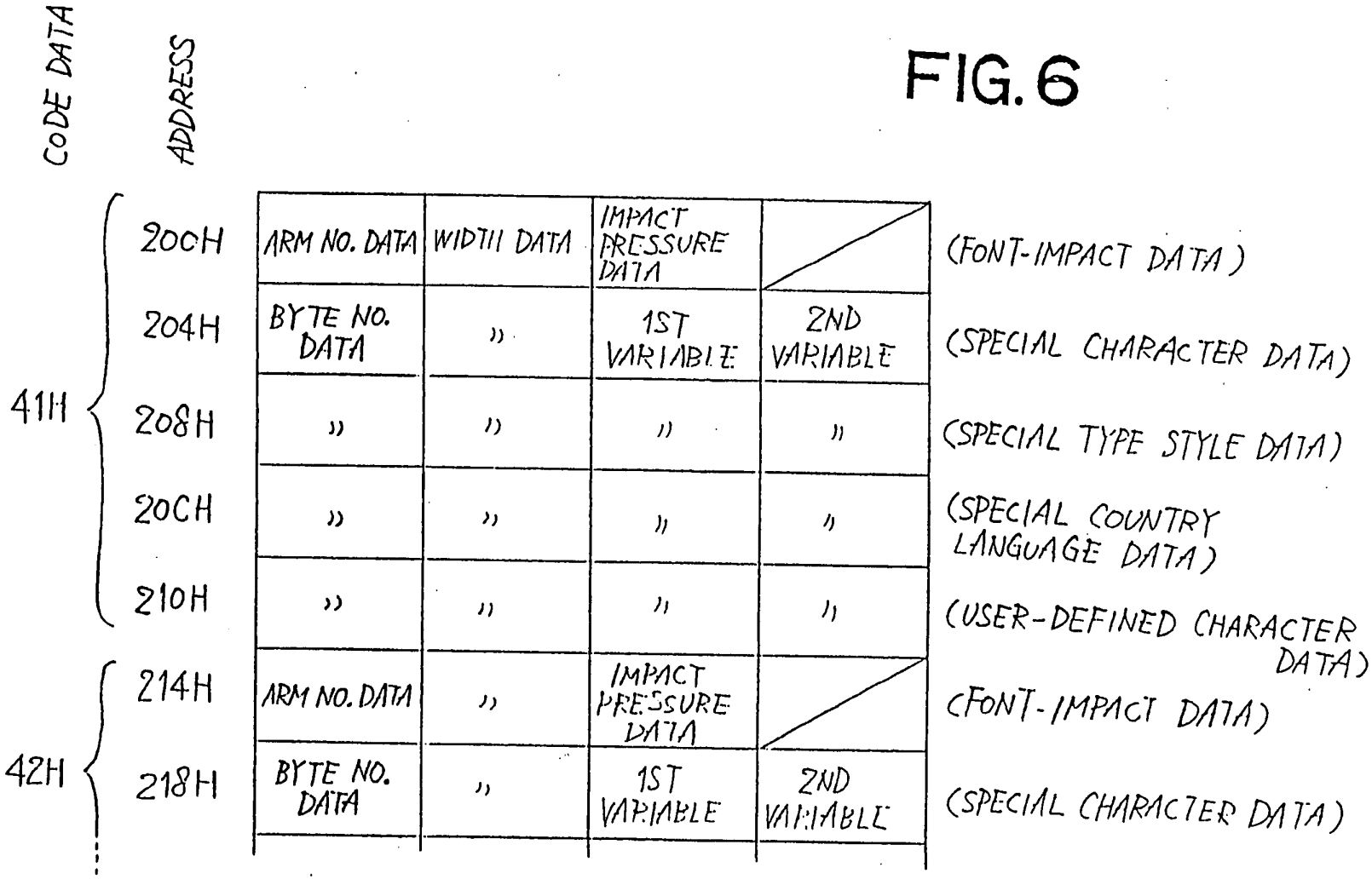
ADDRESS	NUMBER OF BYTES OF MATRIX-PATTERN DATA	TYPE WIDTH (UNIT: 1/60 INCH)	1ST VARIABLE DATA	2ND VARIABLE DATA
400H	72	6	00H	00H
404H	72	6	01H	00H
408H	72	5	02H	00H
⋮	⋮	⋮	⋮	⋮
440H	72	4	40H	00H
⋮	⋮	⋮	⋮	⋮

FIG. 4

FIG.5

CODE DATA	ADDRESS	1ST DISCRIMINATION DATA	2ND DISCRIMINATION DATA
A (41H)	82H	01H	41H
B (42H)	84H	01H	42H
C (43H)	86H	01H	43H
D (44H)	88H	01H	44H
® (45H)	90H	05H	00H
⋮	⋮	⋮	⋮
α (80H)	100H	02H	10H
β (81H)	102H	02H	11H
∫ (F4H)	1E8H	03H	01H
∫ (F5H)	1F0H	03H	02H
⋮	⋮	⋮	⋮

FIG. 6



2219880

2219880

FIG. 7

	CODE DATA	ADDRESS	n	m
A	41H	82H	0	0
B	42H	84H	1	0
C	43H	86H	2	0

CHARACTER OUTPUT DEVICE USING TWO OR MORE SETS OF OUTPUT DATA SETS FOR EACH CHARACTER CODE

The present invention relates generally to a character output device such as a printer or a display device, wherein an output portion such as a printing mechanism or a display unit is controlled according to output data prepared from a series of code data received from input means, so that characters corresponding to the code data are generated on the output portion. More particularly, the invention is concerned with such a character output device wherein a plurality of sets of output data are provided for each set of code data which corresponds to each character, so that the output portion is controlled according to one of the output data sets, which is selected depending upon the desired output condition.

A character output device is adapted such that characters corresponding to two or more sets of code data received from suitable input means are generated at its output portion, according to respective sets of output data which correspond to the code data sets. The output data set for each of the characters available on the character output device is interpreted to mean data necessary to

enable the output portion to generate the corresponding character, for example, a set of print data or display data for activating or controlling a printing mechanism such as a font-impact print head or a dot-matrix print head, or a display unit such as a liquid crystal display,

In a known character output device, two or more sets of output data are available for one set of code data corresponding to each character, and one of these output data sets is selected to generate the corresponding character, as indicated above. This known character output device generally includes (a) memory means for storing a plurality of groups of output data which correspond to respective sets of code data, each group of output data consisting of a plurality of sets of output data which correspond to respective output conditions in which the output portion is controlled, one of the output data sets of each group being selected based on each of the output conditons, for each set of code data, (b) output condition selecting means for selecting one of the output conditions, and (c) output control means for determining the output condition currently selected by the output condition selecting means, each time a code data set corresponding to each character is received from the input means, retrieving one of the output data sets from the memory means, according to the determined output condition, for each code data set, and activating the output portion according to the retrieved output data set, so as to generate the corresponding character.

The output conditions indicated above include, for example, (1) selection of a country language, where the character output device is capable of generating the characters of two or more country languages, (2) selection of a printing mechanism, where the character output device in the form of a printer has two or more selectively operated different types of printing mechanisms, for example, a font-impact print head and a dot-matrix print head, or alternatively two or more selectively operated printing mechanisms of the same type, for example, two or more font-impact or dot-matrix print heads, and (3) designation of conditions such as type style, width, color and density in which the characters are generated on the output portion of the character output device.

In the case where the number of output data sets for each code data set or each character, namely, the number of the output conditions is relatively small, the above known arrangement does not take a data processing time that is too long to be practically acceptable, even if the character output device performs the steps of determining the output condition and selecting one of the two or more output data sets according to the determined output condition, each time the code data for each of the characters to be printed is received from the input means.

However, there is a growing need in the art to increase the number of selectable output conditions, for example, for increasing the number of type styles in which

the characters are printed, displayed or otherwise generated. If the known character output device is adapted to permit an increased number of selectable output conditions for meeting the above need, the time required for the determination of the output condition and the selection of the corresponding output data set for each character is accordingly increased, and the printing of each character takes an accordingly increased time between the moment at which the character output device receives the corresponding code data, and the moment at which the character is generated on the output portion of the character output device. This may not be practically accepted.

In the case of a printer having two or more printing mechanisms, different portions of the same line of characters may be printed by the different printing mechanisms. In this case, the characters of the line are grouped into a plurality of groups, which are printed by the different printing mechanisms, one group after another, by successive activations of the mechanisms. Hence, it is necessary to determine the printing mechanism to be used for each of the line of characters, before the printing is initiated. Thus, the known character output device requires a considerable time between the input of code data and the output of the corresponding character, due to a long data processing time for checking each set of code data in connection with the output conditions.

It is therefore an aim of the present invention to provide a character output device which is capable of efficiently outputting characters, according to a selected one of output data sets for each code data set corresponding to each character, depending upon the desired output condition.

According to the present invention there is provided a character output device for outputting characters on an output portion thereof such as a printing mechanism or a display, according to sets of output data corresponding to respective sets of code data received from input means, so that characters corresponding to the sets of code data are provided on the output portion, comprising: (a) first memory means for storing a plurality of groups of output data which correspond to the respective sets of code data, each of the groups of output data consisting of a plurality of sets of output data which correspond to respective output conditions in which the output portion is operated, one of the sets of output data of the each group being selected based on each of the output conditions, corresponding to each set of code data; (b) second memory means for storing related data which relates to the selected one set of output data which corresponds to each set of code data, the related data designating the selected one set of output data in said first memory means, (c)

output condition selecting means for selecting one of the respective output conditions; (d) data storing control means, operable prior to the operation of the output portion to provide the characters thereon, for determining the above-indicated one set of output data for each set of code data, depending upon the output condition selected by the output condition selecting means, and storing the related data relating to the determined one set of output data, into the second memory means; and (e) output control means for retrieving from the second memory means the related data for each set of code data, retrieving from the first memory means the detrermined one set of output data corresponding to the retrieved related data, and controlling the output portion according to the retrieved set of output data, so as to provide each of the characters which corresponds to each set of code data.

In the character output device of the present invention constructed as described above, one of the output data sets for each code data set is retrieved from the first memory means, depending upon the output condition currently selected by the output selecting means, before the operation of the output portion is initiated to generate the corresponding character. The determination of the above-indicated one output data set corresponding to each code data set is made based on the related data stored in the second memory means, which related data designates that one output data set. Therefore, as long as the same

output condition is selected, the appropriate output data set corresponding to the currently selected output condition can be retrieved from the first memory means, according to the related data stored in the second memory means in relation to each code data set, without having to determine the output condition for each code data set prior to the operation of the output portion to generate the character corresponding to the code data set.

As indicated above, once a certain output condition is selected by the output condition selecting means, the determination as to the output condition is not effected, unless the output condition selecting means is again operated. Therefore, the data processing from the moment of entry of a given code data set up to the time of initiation of the operation of the output portion to generate the corresponding character consists of only the retrieval of the related data from the second memory means, and the retrieval of one of the output data sets from the first memory means, depending upon the retrieved related data. Accordingly, the time required for producing the output data set for the received code data set is considerably reduced, and the operating efficiency of the character output device is improved.

In a first arrangement of the first and second memory means of the character output device of the invention, the first memory means stores the plurality of groups of output data such that each group of the output

data corresponds to each set of code data, and the second memory means stores as the related data position data indicative of each of memory areas of the first memory means in which each set of output data is stored.

In a second arrangement of the first and second memory means, the first memory means has a plurality of memory areas which correspond to the respective output conditions, each of the memory areas storing a plurality of sets of output data which relate to respective sets of code data, and the second memory means stores as the related data for each set of code data, both memory area data indicative of each of the memory areas, and position data indicative of a portion of each memory area in which each of the output data sets is stored.

Where the present invention is embodied in the form of a printer having selectively operated two or more printing mechanisms, the above second arrangement of the first and second memory means is preferred. In this case, the memory areas are provided corresponding to the different printing mechanisms, and the memory area data desigates the printing mechanism used for the relevant code data set. This arrangement permits the determination of the printing mechanism, by referring to the memory area data stored in the second memory means prior to the printing operation corresponding to the relevant code data. Thus, the required printing time after the entry of the code data can be shortened.

The printing mechanisms may include a font-impact print head for printing characters by impacting character fonts against a recording medium, and a dot-matrix print head for printing each character in a matrix of dots. In this case, the first memory means may store font-impact print data for printing standard characters of a standard country language in a standard type style, by the font-impact print head, and one of (a) special character data for printing special characters not included in the standard characters, by the dot-matrix print head, (b) special type style data for printing the standard characters in a special type style, by the dot-matrix print head, (c) special country language data for printing characters used in a special country language different from the standard country language, and (d) user-defined character data for printing characters which are defined by a user of the character output device.

In a printer, the distance in the printing direction between the position of the first character of a relevant line to be printed and the position of the last printed character of the last printed line is shorter if the relevant line is printed in one of the opposite (rightward and leftward) printing directions, than in the other direction. It is desirable to determine the direction of printing of each line so that the above indicated distance is shorter. Where a line of characters is printed by one printing mechanism, the printing of that line

usually starts at the leftmost or rightmost position of the line. However, if a line of characters is printed by two or more printing mechanisms, the leftmost and rightmost positions of the printing range of the characters which are printed first by one of the printing mechanisms change depending upon the first operated printing mechanism. Consequently, prior to starting the printing of that line, it is necessary to determine not only the printing mechanism which is operated first, but also the leftmost and rightmost positions of the printing range of that printing mechanism. In this case, the above-indicated second arrangement of the first and second memory means is advantageous in that the printing mechanism to be used for each code data set can be easily determined by referring to the memory area data for that code data set, which is currently stored in the second memory means. Thus, the direction of printing of the relevant line of characters can be determined in a relatively short time.

In some printers, the feeding speed of the printing mechanism can be changed as desired. In this case, it is necessary to detect or determine the currently selected feeding speed, as one of the output conditions for the printing mechanism. In this case, too, the above-indicated second arrangement of the first and second memory means is suitably employed, so that a plurality of memory areas of the first memory means store respective sets of output data which relate to respective feeding

speeds of the printing mechanism. This arrangement eliminates the determination of the feeding speed for each code data set, since the currently selected feeding speed can be easily determined by simply referring to the memory area data currently stored in the second memory means. Thus, the time for determining the feeding speed can be reduced.

The character output device may further comprise a function memory for storing functional equations for determining, based on said related data, a position of the memory area of the first memory means in which the one set of output data is stored. Where the first memory means has a plurality of memory areas which correspond to the respective output conditions, as described above, the output control means can determine the above-indicated one set of output data, by solving one of the functional equations which is selected by the output condition selecting means, according to the memory area data and position data which are stored in the second memory means.

The above and optional aims, features and advantages of the present invention will be better understood by reading the following description of a presently preferred embodiment of the invention, when considered in connection with the accompanying drawings, in which:

Fig. 1 is a schematic block diagram showing one embodiment of a character output device of the invention, in the form of an electric control system for controlling print heads of a printer;

Fig. 2 is a flow chart illustrating a main control routine stored in a computer of the electric control system;

Figs. 3, 4 and 5 are explanatory views illustrating batches of printing data stored in memories provided in the electric control system; and

Figs. 6 and 7 are explanatory view illustrating batches of printing data stored in memories used in a modified embodiment of the invention.

The presently preferred embodiment of the invention as applied to a printer will be described. The printer has a font-impact print head and a dot-matrix print head, which are indicated at 22 and 26, respectively, in Fig. 1. The font-impact print head 22 uses a type wheel (e.g., daisy type wheel) which has a multiplicity of character fonts fonts formed at free ends of respective radially extending arms, as well known in the art. The type fonts are impacted by suitable means such as hammers, against a recording medium. The dot-matrix print head 26 has a plurality of dot-forming elements (e.g., print wires or pins) for printing characters in a matrix of dots on the

recording medium.

The font-impact print head 22 is used for printing ordinary or standard characters of a standard type style, such as alphabetic letters, numerals and symbols, used in a sepcific country language. The dot-matrix print head 26 are used for printing (1) special characters such as Greek letters and Roman numerals, (2) alphabetic letters of special type styles (different from the standard type style indicated above) used in the above specific country language, such as Pica, Italic and Elite (the number of the special type styles being represented by "N"), (3) standard characters used in country languages other than the specific country language indicated above (the number of these other country languages being represented by "M"), or (4) operator-defined characters which are defined as desired, by the user of the printer.

The electric control system of the printer as shown in Fig. 1 is principally constituted by a computer which incorporates a CPU 10 (central processing unit), a ROM 12 (read-only memory), a RAM 14 (random-access memory), and a bus 16. To the bus 16, there are connected the font-impact print head 22 via a driver circuit 20, and the dot-matrix print head 26 via a driver circuit 24. To the bus 16, there is also connected a character generator 30 (hereinafter abbreviated as "CG 30" as in Fig. 1), which stores a batch of matrix-pattern data representative of all characters that can be printed in a matrix of dots by the

dot-matrix print head 26. The appropriate set of the dot-matrix data is used to activate the dot-matrix print head 26, for printing each character in a dot-matrix pattern.

The ROM 12 has a PROGRAM memory 32 which stores various control routines including a main control routine illustrated in Fig. 2. The ROM 12 also has (a) a FONT IMPACT memory 34 which stores font-impact print data for printing the standard characters of the standard type style by the font-impact print head 22, (b) a SPECIAL CHARACTER memory 36 which stores dot-matrix print data for printing the special characters, as indicated at (1) above, (c) SPECIAL TYPE STYLE memories 38 which store respective batches of dot-matrix print data for printing the alphabetic letters of the special type styles used in the specific country language, as indicated at (2) above (the number of the memories 38 being equal to "N"), (d) SPECIAL COUNTRY LANGUAGE memories 39 which store respective batches of dot-matrix print data for printing the standard characters used in the other country languages, as indicated at (3) above (the number of the memories 39 being equal to "M"), and (e) an OPERATOR DEFINED CHARACTER memory 39 which stores dot-matrix print data for printing the characters which are defined by the user of the printer, as indicated at (4) above. The font-impact print data and the dot-matrix data are stored in these FONT IMPACT, SPECIAL CHARACTER, SPECIAL TYPE STYLE, SPECIAL COUNTRY LANGUAGE and

OPERATOR DEFINED CHARACTER memories 34, 36, 38, 39 and 40, such that the individual sets of font-impact or dot-matrix print data correspond to sets of code data (corresponding to the characters) which can be entered through suitable input means such as a keyboard. The memories 34, 36, 38, 39, 40 will be generally referred to as PRINT DATA memories.

As indicated in Fig. 3, the batch of font-impact print data consists of: data indicative of the numbers of the radial arms of the type wheel of the font-impact print head 22, which carry the respective character fonts; data indicative of the type width of each character font; and data indicative of the level of an impact pressure by which the appropriate character font of the type wheel is impacted against the recording medium. The type width data represents a sum of the width of the character font per se, and a total amount of margins provided on both sides of the character font in the printing direction, and therefore determines or defines a spacing in the printing direction between the adjacent characters to be printed. As indicated in Fig. 4, on the other hand, the batch of dot-matrix print data stored in each of the memories 36, 38, 39, 30 consists of: data indicative of the number of bytes of a set of matrix-pattern data for each character stored in the CG 30; the type width data indicated above; and first variable data and second variable data for calculating the number of the initial address of a memory location of the memories

36, 38, 39, 40 in which the leading portion of the matrix pattern data for each character is stored.

It is to be understood that the present embodiment has first memory means which is constituted by the FONT-IMPACT memory 34, SPECIAL CHARACTER memory 36, SPECIAL TYPE STYLE memories 38 (N1 through Nn), SPECIAL COUNTRY LANGUAGE memories 39 (M1 through Mn), OPERATOR DEFINED CHARACTER memory 40, and CG 30, and that the font-impact print data, dot-matrix print data, and matrix-pattern data function as output data according to which the print heads 22, 26 are activated.

The ROM 12 further incorporates a FUNCTION memory 42 which stores different functional equations which correspond to the PRINT DATA memories 34, 36, 38, 39 and 40. Namely, the number of the functional equations is equal to the number of the PRINT DATA memories. The purpose of the equations will be described.

The RAM 14 includes a CODE DATA buffer 50 for temporarily storing code data representative of one or more lines of characters of a text to be printed, a DISCRIMINATION DATA memory 52 for temporarily storing first discrimination data and second discrimination data (which will be described) for each code data, and a DOT MAP memory 54 for temporarily storing a series of matrix-pattern data for one line of characters.

The input means is adapted to send to the CPU 10 with COUNTRY LANGUAGE data and TYPE STYLE data, before

sending the batch code data of a text to be printed. The COUNTRY LANGUAGE data is indicative of the country language of the characters represented by the subsequently sent code data, while the TYPE STYLE data is indicative of the type style in which the characters are printed. The first discrimination data stored in the DISCRIMINATION DATA memory 52 is prepared according to both of the COUNTRY LANGUAGE data and the TYPE STYLE data, for each set of code data, such that the first discrimination data indicates one of the PRINT DATA memories 34, 36, 38, 39, 40 in which the print data (font-impact print data or dot-matrix print data) corresponding to each set of code data is stored. The second discrimination data also stored in the DISCRIMINATION DATA memory 52 indicates the address number of the memory location or area of the above-indicated one PRINT DATA memory in which the print data for each set of code data is stored.

In the present embodiment, the sets of first discrimination data corresponding to the sets of code data are stored at the address numbers of the DISCRIMINATION DATA memory 52 which are two times as large as the values of the codes of the code data, and the sets of second discrimination data are stored at the address numbers of the memory 52 which are larger by one than the above-indicated address numbers. It is to be understood that the DISCRIMINATION DATA memory 52 functions as second memory means for storing RELATED DATA consisting of the

first and second discrimination data which relate to the output data (font-impact print data, dot-matrix print data and matrix-pattern data) which has been described above.

The operation of the present embodiment of the invention will next be described.

When the printer is turned on, the main control routine of Fig. 2 is executed. Initially, the control flow goes to step S1 in which the CPU 10 receives the COUNTRY LANGUAGE data from the input means. Then, step S2 is executed to receive the TYPE STYLE data from the input means. Step S3 is followed by step S2 in which the CPU 10 prepares the first discrimination data and second discrimination data for each of a plurality of predetermined code data, according to the received COUNTRY LANGUAGE and TYPE STYLE data. The prepared first and second discrimination data are stored in the DISCRIMINATION DATA memory 52.

Then, the control flow goes to step S4 to determine whether a "PRINT START" command has been received from the input means. If the command is present, step S4 is followed by step S5 in which the CPU 10 receives from the CODE DATA buffer 50 a series of code data corresponding to one line of characters. In the next step S6, the CPU 10 determines, based on the first discrimination data, whether the line of characters represented by the series of code data includes a character or characters (font-impact characters) which is/are printed by the font-impact print

head 22. More specifically, the DISCRIMINATION DATA memory 52 is scanned to determine whether the first discrimination data at the address number which is two times as large as the value of each set of code data designates the FONT IMPACT memory 34, or not. In the present embodiment, the first discrimination data designating the FONT IMPACT memory 34 is "01H", as indicated in Fig. 5. If the relevant line of characters includes any font-impact characters, step S6 is followed by step S7 in which the appropriate one of the functional equations which corresponds to the first discrimination data ("01H") designating the FONT IMPACT memory 34 is retrieved from the FUNCTION memory 42, and the set of font-impact print data corresponding to each font-impact character is retrieved from the address of the FONT IMPACT memory 34 whose number is calculated by solving the functional equation according to the first and second discrimination data. In the next step S8, the print head 22 is activated according to the retrieved sets of font-impact print data, whereby the font-impact characters are printed.

Step S6 is followed by step S9 if the line of characters represented by the series of code data received from the CODE DATA buffer 50 does not include any font-impact characters to be printed by the font-impact print head 22. Step S6 is also followed by step S9 when the font-impact character or characters included in the relevant line of characters has/have been printed as a

result of execution of steps S7 and S8. In step S9, the CPU 10 determines, based on the first discrimination data, whether the relevant line of characters represented by the series of code data includes any character or characters (dot-matrix characters) to be printed by the dot-matrix print head 26. More specifically, the DISCRIMINATION DATA memory 52 is scanned to determine whether the first discrimination data at the address number which is two times as large as the value of each set of code data designates any one of the dot-matrix print data memories, i.e., SPECIAL CHARACTER memory 36, SPECIAL TYPE STYLE memories 38, SPECIAL COUNTRY LANGUAGE memories 39 and OPERATOR DEFINED CHARACTER memory 40, or not. If the relevant line of characters does not include any dot-matrix characters, the control flow goes back to step S4. If any dot-matrix characters are present, step S9 is followed by step S10 in which (1) the DOT MAP memory 54 is first cleared; (2) the appropriate one of the functional equations which corresponds to the first discrimination data designating each of the above-indicated dot-matrix print data memories is retrieved from the FUNCTION memory 42; (3) then, the address number of the relevant dot-matrix print data memory (36, 38, 39, 40) is calculated by solving the retrieved functional equation according to the first and second discrimination data; (4) the set of dot-matrix print data corresponding to the relevant dot-matrix character is retrieved by the calculated address number of

the relevant dot-matrix print data memory; (5) the initial address number of the memory area of the CG 30 in which the matrix-pattern data corresponding to the relevant dot-matrix character is stored is calculated based on the first variable data and the second variable data of the retrieved set of dot-matrix print data; and (6) the set of matrix-pattern data is retrieved from the address number of the CG 30. The above sequence of operation is performed in step S10, for all the dot-matrix characters to be printed by the dot-matrix print head 26. In the next step S11, the thus retrieved matrix-pattern data is stored into the DOT MAP memory 54. Step S11 is followed by step S12 in which the dot-matrix print head 26 is activated according to the dot-matrix print data stored in the dot-matrix data memory or memories (36, 38, 39, 40) and according to the matrix-pattern data stored in the DOT MAP memory 54. The control flow then goes back to step S4.

When the printer is turned on after it is turned off, the CPU 10 again receives the COUNTRY LANGUAGE data and the TYPE STYLE data from the input means; and stores the first and second discrimination data in the DISCRIMINATION DATA memory 52, according to the received COUNTRY LANGUAGE and TYPE STYLE data. If the presently received COUNTRY LANGUAGE and TYPE STYLE data are different from those received in the previous printing operation, different characters, or same characters of a different type style are printed even if the same series of code data

as previously received are received from the input means, since the first and second discrimination data currently stored in the DISCRIMINATION DATA memory 52 are different from those previously stored in the memory 52. The content of the DISCRIMINATION DATA memory 52 is updated each time the COUNTRY LANGUAGE and TYPE STYLE data are newly entered. These newly entered data may or may not be the same as the data previously entered. All sets of the first and second discrimination data corresponding to all code data may be newly prepared and stored irrespective of whether these data remain unchanged, or only the sets of these discrimination data that are different from the previously stored sets may be substituted for the previous ones.

It will be understood from the foregoing description that a batch of data relating to the font-impact print data and/or the dot-matrix print data, i.e., batches of the first and second discrimination data are stored in the DISCRIMINATION DATA memory 52, corresponding to the code data for all characters available on the printer, according to the COUNTRY LANGULAGE and TYPE STYLE data which are entered when the printer is turned on. In printing a line of characters, the first and second discrimination data corresponding to a series of code data for that line of characters are retrieved from the DISCRIMINATION DATA memory 52, without checking the COUNTRY LANGUAGE and TYPE STYLE data for the code data for each character. The font-impact print data and/or the dot-matrix

print data are retrieved from the appropriate PRINT DATA memory or memories 34, 36, 38, 39, 40. Therefore, it is not necessary to check the country language and the type style of each character of a print line each time the code data for that character is received, whereby the overall time spent from the time of entry of the code data up to the completion of printing of the line is significantly reduced.

Further, the determination as to whether each character corresponding to each set of code data should be printed by the font-impact print head 22 or by the dot-matrix print head 26 can be accomplished by simply checking the first discrimination data for that character, prior to initiating the printing of each line of characters. Thus, it is not necessary to determine the mode of printing of each character, by referring to the country language data and the type style data, each time a set of code data for each character is received, as practiced in the known control device.

It is to be understood that the portions of the control system which store control data for steps S1 and S2 and execute these steps function as means for determining the output conditions of the control system in which the print heads 22, 26 are activated according to the code data, and that the COUNTRY LANGUAGE data and the TYPE STYLE data represent the output conditions of the control system. It is further to be understood that the portions of the

control system which store coantrol data for step S3 and execute this step function as data storing control means for preparing and storing the first and second discrimination data into the DISCRIMINATION DATA memory 52, according to the received COUNTRY LANGUAGE and TYPE STYLE data. It is also to be understood that the portions of the control sytem which store control data for steps S6-S12 and execute these steps function as output control means for controlling the print heads 22, 26 according to the print data which is prepared based on the code data and depending upon the output conditions or first and second discrimination data. It is noted that the printing mechanism which includes the font-impact print head 22 and the dot-matrix print head 26 constitutes an output portion of the character output device in the form of a printer.

Referring next to Figs. 6 and 7, there will be described a modified embodiment of the present invention. The printer according to this embodiment uses a single PRINT DATA memory as shown in Fig. 6, and a DISCRIMINATION memory as shown in Fig. 7. The PRINT DATA memory of Fig. 6 is substituted for the PRINT DATA memories 34, 36, 38, 39 and 40 used in the preceding embodiment. The DISCRIMINATION memory of Fig. 7, which corresponds to the DISCRIMINATION DATA memory 52, is adapted for use with the PRINT DATA memory of Fig. 6.

More specifically, the PRINT DATA memories 34, 36, 38, 39 and 40 of the preceding embodiment correspond to the

output conditions in which the print heads 22, 26 are operated to print the characters according to the received code data. In each of the memories 34, 36, 38, 39, 40, the font-impact print data or dot-matrix print data is stored, corresponding to all sets of code data corresponding to the characters available on the printer. However, the PRINT DATA memory of Fig. 6 stores, for each set of code data, a series of font-impact data, special character data, special type style data, special country language data and user- or operator-defined data, which are all stored in the memories 34, 36, 38, 39, 40 in the preceding embodiment. As shown in Fig. 6, a batch of font-impact data and dot-matrix data for each code data is stored at a plurality of addresses of the memory. For example, the font-impact data for code data "41H" is stored at addresses 200H-202H, and the user-defined character data (part of the dot-matrix data) for the same code data is stored at addresses 210H-213H. The font-impact data for the next code data "42H" is stored at addresses 214H-217H following the last address 213H used for the code data "41H".

The addresses of the PRINT DATA memory of Fig. 6 can be designated according to the discrimination data "n" and "m" stored in the DISCRIMINATION DATA memory of Fig. 7, depending upon the received code data and the selected output condition. The discrimination data "n" is determined by the received code data, while the discrimination data "m" is determined by the currently selected output

condition. Suppose the code data corresponding to character "B" is received with the font-impact print head 22 designated as the output condition, the data "n" is "1" corresponding to the character "B", and the data "m" is "0" corresponding to the selected output condition (i.e., printing by the font-impact print head 22), as indicated in Fig. 7. These data "n" and "m" are used in a functional equation N = 200H + [(5H x n) + m] x 4H stored in the FUNCTION memory 42, where N represents the address No. of the PRINT DATA memory of Fig. 6. In the above case, N is equal to "214H" (in hexadecimal notation).

In the illustrated embodiments, the printer receives the COUNTRY LANGUAGE and TYPE STYLE data representative of the output conditions, from the input means which is separate from the printer. However, the printer may be provided with suitable operator-controlled means for designating or selecting the output conditions of the control system for controlling the output unit (print heads 22, 26) of the printer.

In the illustrated embodiments, the output conditions are established upon application of power to the printer, and the established conditions are maintained until the printer is turned off. However, the input means may be adapted to provide the printer with the output conditions each time a PRINT START command is generated by the input means to effect a printing cycle for printing a series of characters. In this case, the output conditions

may be changed upon starting of each of the printing cycles to be effected in response to the PRINT START commands supplied from the input means while the printer is held on. It is also possible to change the output conditions and update the discrimination data, during a printing cycle of a series of characters, i.e., for a portion of the relevant code data which has not been executed.

While the illustrated printer has both the font-impact print head 22 and the dot-matrix print head 26 which are operated alone or in combination, the principle of the invention may be applied to a printer which uses only one of the print heads 22, 26, or two or more print heads of the font-impact type or dot-matrix type.

The PRINT DATA memories 34, 36, 38, 39, 40 and the CG 30 may be provided in the form of respective cartridges which are removably and selectively installed on the printer. In this case, the use of the appropriate cartridge or cartridges in addition to or in place of the standard cartridge or cartridges makes it possible to print the standard characters in special type styles, or under special printing conditions with special print widths, colors and ink density, or special characters (not included in the standard characters) in the standard or a special type style, under the standard or special printing conditions. This modular arrangement enhances the versatility or freedom of the printer in meeting the user's requirements for printing a variety of characters in

desired forms.

Although the printer of the illustrated embodiments is a serial printer with the movable print heads, the present invention is equally applicable to a line printer or a page printer.

It is noted that the output unit to which the present invention is applicable may be devices or units other than a printing mechanism of a printer, for example. For example, the invention may be embodied as a character output device in the form of a display device such that the characters are displayed according to code data and depending upon selected output conditions.

It is to be understood that the present invention may be embodied with various other changes, modifications and improvemens, which may occur to those skilled in the art, without departing from the spirit and scope of the invention defined in the following claims.

CLAIMS:

1. A character output device for outputting characters on an output portion thereof such as a printing mechanism or a display, according to sets of output data corresponding to respective sets of code data received from input means, so that characters corresponding to the sets of code data are provided on said output portion, comprising:

first memory means for storing a plurality of groups of output data which correspond to the respective sets of code data, each of said groups of output data consisting of a plurality of sets of output data which correspond to respective output conditions in which said output portion is operated, one of said sets of output data of said each group being selected based on each of said output conditions, corresponding to each set of code data;

second memory means for storing related data which relates to said selected one set of output data which corresponds to said each set of code data, said related data designating said one set of output data in said first memory means;

output condition selecting means for selecting one of said respective output conditions;

data storing control means, operable prior to operation of said output portion to provide said characters thereon, for determining said one set of output data for

said each set of code data, depending upon the output condition selected by said output condition selecting means, and storing said related data relating to the determined one set of output data, into said second memory means; and

output control means for retrieving from said second memory means said related data for said each set of code data, retrieving from said first memory means said one set of output data corresponding to the retrieved related data, and controlling said output portion according to the retrieved set of output data, so as to provide each of said characters which corresponds to said each set of code data.

2. A character output device according to claim 1, wherein said first memory means stores said plurality of groups of output data such that said each group corresponds to said each set of code data, and said second memory means stores as said related data position data indicative of each of memory areas of said first memory means in which said each set of output data is stored.

3. A character output device according to claim 1, wherein said first memory means has a plurality of memory areas which correspond to said respective output conditions, each of said memory areas storing a plurality of sets of output data which relate to respective sets of

code data, and said second memory means stores as said related data for said each set of code data, both memory area data indicative of each of said memory areas, and position data indicative of a portion of said each memory area in which each of said sets of output data is stored.

4. A character output device according to any one of claims 1-3, wherein said output portion includes a plurality of printing mechanisms which are selectively operated, and said data storing control means is responsive to output condition data which includes data indicative of one of said plurality of printing mechanisms.

5. A character output device according to claim 4, wherein said plurality of printing mechanisms include a font-impact print head for printing characters by impacting character fonts against a recording medium, and a dot-matrix print head for printing each character in a matrix of dots.

6. A character output device according to claim 5, wherein said first memory means stores font-impact print data for printing standard characters of a standard country language in a standard type style, by said font-impact print head, and one of (a) special character data for printing special characters not included in said standard characters, by said dot-matrix print head,

(b) special type style data for printing said standard characters in a special type style, by said dot-matrix print head, (c) special country language data for printing characters used in a special country language different from said standarad country language, and (d) user-defined character data for printing characters which are defined by a user of the character output device.

7. A character output device according to any preceding claim, further comprising a function memory for storing functional equations for determining, based on said related data, a position of the memory area of said first memory means in which said one set of output data is stored.

8. A character output device according to claim 7, wherein said first memory means has a plurality of memory areas which correspond to said respective output conditions, each of said memory areas storing a plurality of sets of output data which relate to respective sets of code data, and said second memory means stores first and second discrimination data as said related data for said each set of code data, said first discrimination data indicating each of said memory areas, and said second discrimination data indicating the position of said each memory area in which each of said sets of output data is stored, said output control means determining said one set

of output data, by solving one of said functional equations which is selected by said output condition selecting means, according to said first and second discrimination data.

9. A character output device according to any preceding claim, wherein said output condition selecting means selects one of said output conditions, according to data received from said input means.

10. A character output device constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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